memoirs on groups of insects. The first section of this volume is by J. Weise, of Berlin, and describes the Chrysomelidæ and Coccinellidæ, of which the expedition obtained twenty-eight species, of which nine are new. The second section is by Dr. Bernhauer, and describes the Staphylinidæ, and founds eleven new species, one of which is the type of a new sub-genus. The third section, by Georg Ulmer, of Hamburg, describes the Trichoptera and Ephemeridæ, and includes a synopsis of the Trichoptera known on the Australian continent. This report is illustrated by a valuable series of drawings in the text. Five new species are described, and many larval forms. The fourth section, by F. Silvestri, describes the Thysanura, including fifteen species of Lepisma and one of Japygus. Twelve of the species are new, and one of them represents a new genus. The report is illustrated by ten plates.

The volume gives further evidence of the valuable additions to Australian zoology made by Prof. Michaelsen and Dr. Hartmeyer's expedition.

*Lehrbuch der Muskel- und Gelenkmechanik.* By Prof. H. Strasser. I. Bd. Allgemeiner Teil. Pp. xi+212. (Berlin: Julius Springer, 1908.) Price 7 marks.

THIS book is the work of one who has made animal mechanics a life-study. Prof. Strasser will be particularly remembered on account of his work, published some twenty years ago, upon the flight of birds and the swimming of fish.

The first section of his book—some seventy-three pages—is devoted to an admirable digest of the mechanical principles involved. It is illustrated by plenty of figures.

The second part is devoted to the skeleton, the mechanical prop; the movements at the joints; the different forms of muscle, the angles which the individual fibres make when inserted into bone, and muscle work.

The third section refers to the general problem of the joints and muscles, and deals with several static problems in the first case, and with locomotion in the second.

The author has treated the whole subject much as one would treat an ordinary physical problem, in all mathematical detail. He is to be congratulated upon his method and upon the way in which he has carried it out. We believe that there is no treatise in the English language which can be considered as quite on all fours with his book, and we can heartily recommend its study.

## LETTERS TO THE EDITOR.

*[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.]*

### Diurnal and Semi diurnal Atmospheric Variations.

I HAVE read the remarks of Prof. Horace Lamb in NATURE, November 5, 1908, p. 24, and November 12, 1908, p. 47, where, although mentioning difficulties, he apparently accepts the suggestions of Kelvin, Margules, and Hann that the semi-diurnal wave of pressure can be explained by the fact that " the daily variation of temperature is not harmonic, and when analysed there is a definite component with a half-day period," and " on a rotating earth the period of free oscillation of the atmosphere lies very near to twelve hours."

In connection with this, I wish to direct attention to the

fact that an analysis of the records of instruments carried by kites shows that the chief oscillation in temperature in the body of the atmosphere is a semi-diurnal one, and not a single oscillation such as is found near the ground.

In a discussion of the observations obtained with kites at the Blue Hill Meteorological Observatory, published in the annals of the Astronomical Observatory of Harvard College, vol. lviii., part i., 1904, I showed that the single diurnal oscillation of temperature nearly disappears within 300 metres of the earth's surface, and from 500 metres to 1500 metres only a semi-diurnal oscillation is distinctly apparent.

For the method employed the reader must be referred to the publication mentioned. The final results in degrees Fahrenheit were as follows :—

*Normal Diurnal Temperatures at different Levels above Blue Hill.*

| Height in metres | A.M. | | | | | P.M. | | | | | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 3 | 5 | 7 | 9 | 11 | 1 | 3 | 5 | 7 | 9 | 11 | |
| 15 | 39·9 | 37·9 | 37·7 | 39·4 | 47·9 | 51·8 | 53·8 | 53·9 | 51·5 | 47·2 | 42·8 | 41·2 | 45·4 |
| 500 | 45·7 | 46·0 | 45·6 | 44·6 | 43·5 | 44·1 | 45·8 | 45·8 | 44·2 | 43·2 | 43·6 | 44·6 | 44·7 |
| 1000 | 40·4 | 40·4 | 40·5 | 40·4 | 39·8 | 40·1 | 40·5 | 40·4 | 40·3 | 40·3 | 40·0 | 40·0 | 40·2 |
| 1500 | 37·5 | 36·9 | 36·5 | 36·8 | 36·0 | 34·5 | 35·2 | 36·4 | 36·1 | 34·7 | 34·9 | 36·9 | 36·0 |

The harmonic values computed from the observations are as follows, the epoch in each case being midnight :—

| Height | Harmonic values |
|---|---|
| 15 m. ... | $45·4+8·33 \sin (234+x)+1·63 \sin (73+2x)+\&c.$ |
| 500 m. ... | $44·7+0·47 \sin (13+x)+1·67 \sin (18+2x)+\&c.$ |
| 1000 m. ... | $40·2+0·09 \sin (85+x)+0·35 \sin (344+2x)+\&c.$ |
| 1500 m. ... | $36·0+0·90 \sin (47+x)+0·80 \sin (0+2x)+\&c.$ |

These results show that the amplitude of the single diurnal period near the earth's surface (15 metres above sea-level) is 8°·3 F., but at 500 metres it has decreased to less than half a degree Fahrenheit, and at 1000 metres to less than a tenth of a degree Fahrenheit. At 1500 metres the range apparently increases somewhat, but this is perhaps owing to the small amount of data available at that height. The mean of all the daily ranges between 500 metres and 1500 metres, inclusive, is slightly less than half a degree. Furthermore, at 500 metres to 1500 metres the phase angle has changed nearly 180° as compared to that at the earth's surface, so that the maximum in the daily wave of temperature comes at night instead of during the day. The reversal of phase apparently takes place between 300 metres and 500 metres.

Turning to the values in the formula showing the semi-diurnal period, it is seen that at 500 metres and 1000 metres the amplitude is nearly four times as great as is the amplitude of the diurnal period, but at 1500 metres the two appear to be nearly equal. The maxima in temperature are about 3 a.m. and 3 p.m., not far in time from the semi-diurnal minima of pressure, while the minima of temperature are near 9 a.m. and 9 p.m., not far from the times of the semi-diurnal maxima of pressure.

In commenting on these results in the publication referred to, I say (p. 32) :—" But the fact of particular interest is that the mean of the amplitudes of the semi-diurnal period from 500 to 1500 metres, thus including the larger portion of the lower atmosphere, is greater than the mean amplitude of the diurnal period. This fact is of interest in connection with the views of Lord Kelvin, Dr. Margules, and Dr. Hann concerning the cause of the semi-diurnal wave."

In 1905 Prof. Frank H. Bigelow, analysing the data obtained at Blue Hill more in detail and by a method somewhat different from my own, confirmed the existence of the semi-diurnal period of temperature in the body of the atmosphere. He says :—" The single diurnal period at the surface is replaced by a double diurnal wave at 400 metres, and this appears quite plainly in every month except July, where it is probably nearly extinct " (*Monthly Weather Review*, 1905, p. 55).

The existence of a maximum of temperature by day and a secondary maximum at night, with a diurnal amplitude of about 1°·3 C. at a height of 1200 metres above Hald, Denmark, has also been disclosed by W. Wundt in an analysis of the observations made with kites at that station (*Meteorologische Zeitschrift*, 1908, pp. 337–41).

Herr Wundt gives results for the year and for the autumn, the semi-diurnal period being most marked in the autumn, for which I find the following harmonic values :—

| Height | Harmonic values |
|---|---|
| 1200 m. | A + 0·37 sin (228 + x) + 0·13 sin (229 + 2x) + &c. |

In this case the amplitudes are in degrees centigrade, and must be multiplied by 1·8 for comparison with the results at Blue Hill. The amplitude of the single diurnal oscillation is nearly the same as the mean between 1000 metres and 1500 metres at Blue Hill, but the phase angle is nearly 180° different. The amplitude of the double diurnal period is a little less than half that found for Blue Hill. However, the method of obtaining the original data was not the same in the two cases.

HENRY HELM CLAYTON.

Readville, Mass., January 8.

### A Method of Solving Algebraic Equations.

PROF. RONALD ROSS gave in NATURE of October 29, 1908, an article upon " A Method of solving Algebraic Equations." Without going into the matter itself, or into details concerning it, I beg to state that the above-mentioned process was published in Germany in 1894 in the two following articles by Dr. W. Heymann, professor an der Kgl. Gewerbe-Academie zu Chemnitz in Sachsen :—

(1) Ueber die Auflösung der Gleichungen vom funften Grade (*Zeitschrift für Mathematik und Physik*, xxxix., Jahrgang 1894).

(2) Theorie der An- und Umläufe und Auflösung der Gleichungen vom vierten, fünften und sechsten Grade mittels goniometrischer und hyperbolischer Funktionen (*Journal für die reine und angewandte Mathematik*, cxiii. Band, 1894).

Further publications relating to the same subject, and also by Prof. Heymann, are as follows :—

(3) Ueber die elementare Auflösung transcendenter Gleichungen. Mit Beiträgen zur Ingenieur-Mathematik (*Zeitschrift für mathematischen und naturwissenschaftlichen Unterricht*, xxix., Jahrgang 1898).

(4) Ueber Wurzelgruppen, welche durch Umläufe ausgeschnitten werden (*Zeitschrift für Mathematik und Physik*, xlvi. Band, 1901).

I would especially mention, as an article which deals at some length with the geometric explanation of the iteration-process :—

(5) Ueber die Auflösung von Gleichungen durch Iteration auf geometrischer Grundlage (*Jahresbericht*, 1904, *der Techn. Staatslehranstalten zu Chemnitz*).

The author has in this last work thoroughly explained the staircase procession and alternating spiral procession theories, and has also developed the technology of the process, which he further illustrates by a great number of practical examples. I would here direct attention to the fact that this method can be used with advantage in solving transcendant equations. Dr. Heymann has also especially considered in this work those spirals which do not immediately stagnate, but which do so after repeated revolutions; he divides them, therefore, into spirals of the first, second, third . . . *m*th kind.

GEORG SATTLER.

I AM much obliged to Herr Sattler for the information which he has been kind enough to give in regard to my article in NATURE of October 29, 1908, and also for sending me the paper by Prof. Heymann (No. 5) to which he refers. When I wrote my article I could obtain no information concerning previous literature on the method, but since then Mr. W. Stott, secretary of the Liverpool Mathematical Society, has assisted me very greatly with his knowledge of the history of mathematics and with the books in his possession. We are now engaged in making a thorough study of the history of the method, but the following brief account of our progress up to the present may not be out of place.

The method appears to have been discovered by Michael Dary, a gunner in the Tower of London, on August 15, 1674, and was communicated by him in a letter of that date to Isaac Newton (see the " Macclesfield Letters," Correspondence of Scientific Men of the Seventeenth Century, University Press, Oxford, 1841, vol. ii., p. 365). In this letter he indicates clearly that a root of a trinomial equation can be obtained by putting the equation in the form $z^p = az^q + n$, and then by approximating to the value by " iteration "—just as described in my paper. Subsequently he wrote a book called " Interest Epitomised, both Compound and Simple, whereunto is added a Short Appendix for the Solution of Adfected Equations in Numbers by Approachment performed by Logarithms " (London, 1677), but we have not yet been able to procure a copy of this work. Dary was a *protégé* both of Isaac Newton and of Collins. The former subscribed himself in a letter to Dary " your loving friend "; and the latter (to judge by the same " Letters," vol. i., p. 204) tried to advance him, and wrote of him :— " 'Tis well known to very many that Mr. Dary hath furnished others with knowledge therein (arithmetic), who, publishing the same, have concealed his name ; as, for instance, Dr. John Newton hath lately published a book of Arithmetic, another of Gauging; all that is novel in both he had from Mr. Dary."

I do not know the date when the great Newton first described his method of approximation, but fancy that it must have been done in his " Universal Arithmetic," written about 1669 (the method has been also ascribed to Briggs). The matter is of some interest, because Newton's method is a variant of Dary's—or rather both are special cases of a more general method. In approximating to the intersection of two curves by iteration we may employ either an orthogonal or an oblique geometric construction. The former is the method of Dary (as illustrated in my paper), the latter is the method of Newton, the angle of the oblique construction varying at each step and being taken as that of the tangent of one of the curves at the starting point of the step. Obviously the oblique process gives the quicker approach, and Newton's

$$(x_2 = x_1 - fx_1/f'x_1)$$

gives the quickest possible if we start sufficiently near the root. Newton was probably aware of this, and consequently did not elaborate Dary's method. Nevertheless, Dary's method is, with certain modifications, the more certain ; and, at any step, we can pass from the one process to the other.

The subject now becomes divided into two, the functional theorem, that an iterated function may converge toward the root of an equation, and the converse theorem, that the root of an equation may be calculated by the iteration of a function. The next work which I have seen on the latter theorem is contained in the appendix to the third edition (1830) of Legendre's " Theorie des Nombres " (copies of the second edition may not possess the appendix). He calls this " Méthodes nouvelles pour la Résolution approchée des Équations numeriques," but begins with Newton's method (without acknowledgment) and continues with Dary's. Legendre's paper is curious. He gives the geometric representation of both methods, but omits entirely the " spiral process " mentioned in my paper. We cannot suppose that such a master was ignorant of that process, but must rather believe that he put it aside because he thought it inconvenient for practical calculation (which is not the case if suitable precautions are taken). In order to confine himself to the " staircase process " he puts the proposed equation in the form of " fonctions omales " (homalous), but with the result only that he must often obtain a very slow convergency. In order to extract the successive roots he makes no better suggestion than to divide out the first root already obtained, and the idea of starting the process alternately on the two curves in order to obtain one root after another seems not to have occurred to him. His paper is ingenious, but insufficiently generalised. Prof. Heymann has criticised it to the same effect.

Heymann mentions a number of contributors on the functional side of the theorem, Jakob Bernoulli, Gauss, Jakobi, Stern, Schlömilch, Schröder, Günther, von Schaewen, Hoffmann, Netto, and Isenkrahe. Possibly Babbage, Boole, Galois, and De Morgan may have done as much at an earlier date than some of these writers. De Morgan, in his article on the calculus of functions (" Encyclopedia Metropolitana," London, 1845, vol. ii.,